

# *2003 Portfolio and Project Review*

## **Materials Portfolio**

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Industrial Technologies Program

Washington, DC  
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Office of Energy Efficiency and Renewable Energy  
U.S. Department of Energy



- ITP – Materials
- Portfolio
  - Focus Areas
  - Barrier-Pathway Approach
  - Partners
- Highlights
- Priorities, Plans and Activities



# Industrial Technologies

*Buddy Garland, Program Manager*

Technology Delivery

## Advanced Process Systems

- Materials, Sensors & Automation
- Metals & Mining

## Chemical and Enabling Technologies

- Industrial Energy Systems
- Chemical & Allied Processes



# Materials, Sensors & Automation

## DOE Headquarters

- Sara Dillich: Lead Technology Manager
  - Materials
- Elliott Levine - Glass
- Gideon Varga - Sensors and Automation

## DOE- GO:

- Mahesh Jha: Materials Projects Manager



# Materials sub-program Support

- Pete Angelini (ORNL)
- Ross Brindle (Energetics)
- Bill Choate (BCS)
- Roy Tiley (BCS)
  
- Glenn Whichard (Sayres) - full time Materials support
- Scott Birkmire: Golden Office Materials Support



## ITP Materials Sub-program

# MISSION

**Mission** - Lead a national effort to research, design, develop, engineer, and test new and improved materials for energy efficiency in industrial processing and manufacturing.

FY03

\$12.7M

FY04

\$12.7M

FY05(request)

\$11M



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# Portfolio

- Focus Areas
- Barrier-Pathway Approach
- Partners



# Analysis-Guided Planning

## Activity

- Program Goal Setting
- Technology Area Planning
  - Focus Areas
  - Project Solicitation



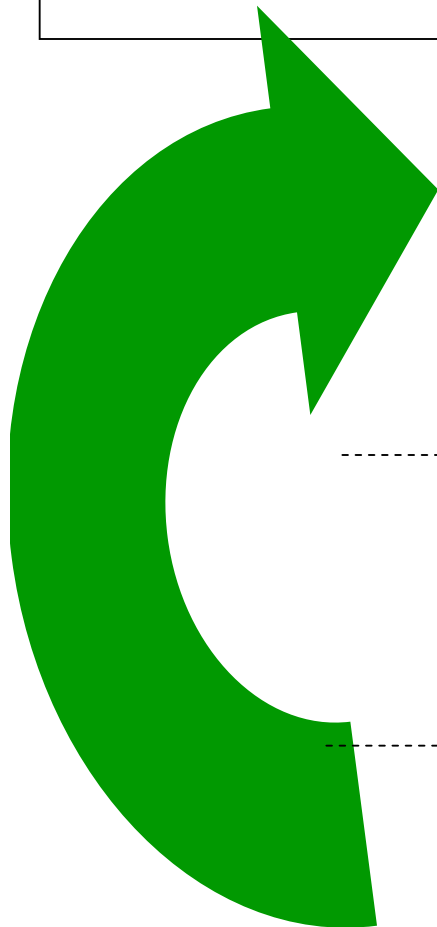
Project Selection  
& Execution



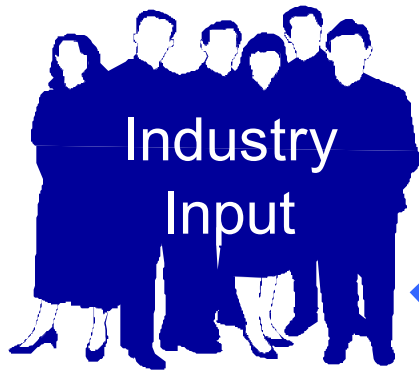
Assessment  
& Evaluation

## Supporting Analysis

- Roadmaps
- Energy Opportunity Analyses
- Barrier/Pathway Approach
- Expert Merit Reviews
- GPRA
- Detailed Milestone Tracking (CPS)
- Corporate & Portfolio Peer Review
- Follow-Up Studies



# Program Planning Inputs



ITP  
Strategic  
Plan



Focus Areas



Analytic Studies



Barriers/R&D Pathways





# Summary of Materials R&D Focus Areas

## ***Focus Area***

## ***Goal***

1. Degradation-Resistant Materials



Improve the corrosion and wear resistance of industrial materials; improve high-temperature performance of refractories.

2. Thermophysical Databases and Modeling



Improve the availability, accuracy, and accessibility of property data required to understand, simulate, and optimize materials used in industrial processes.

3. Materials for Separations



Research, design, develop, engineer, and test new and improved materials for separation.

4. Materials for Engineering Applications



Improve material properties and develop appropriate fabrication methods for industrial processing applications.



# Focus Areas Address Crosscutting IOF Needs

## **1. Degradation-Resistant Materials (19 projects)**

- Alloy and composites development
- Advanced processing methods and coatings
- Refractories

## **2. Thermophysical Databases and Modeling (4 projects)**

- High-temperature materials data and performance prediction
- Degradation prediction
- Combinatorial methods for alloy design

## **3. Materials for Separation (2 project)**

- Membranes, catalysts, zeolites
- Advanced Chlor Alkali Technology

## **4. Materials for Engineering Applications (10 projects)**

- Tools and dies, joining and weld assessments, advanced materials solutions for enhanced heat recovery and reliability



# Studies to Identify Barriers and Priorities

- **Degradation Resistance:**
  - Refractories Opportunity Analysis (draft for review)
  - Energy Cost of Corrosion (initiated)
- **Thermophysical Databases and Modeling:**
  - Opportunities Analysis (in preparation)
- **Materials for Separation:**
  - Opportunities Analysis (draft for review)
- **Materials for Engineering Applications:**
  - **Materials for Waste Heat Recovery and Reuse**
  - Others in planning stages



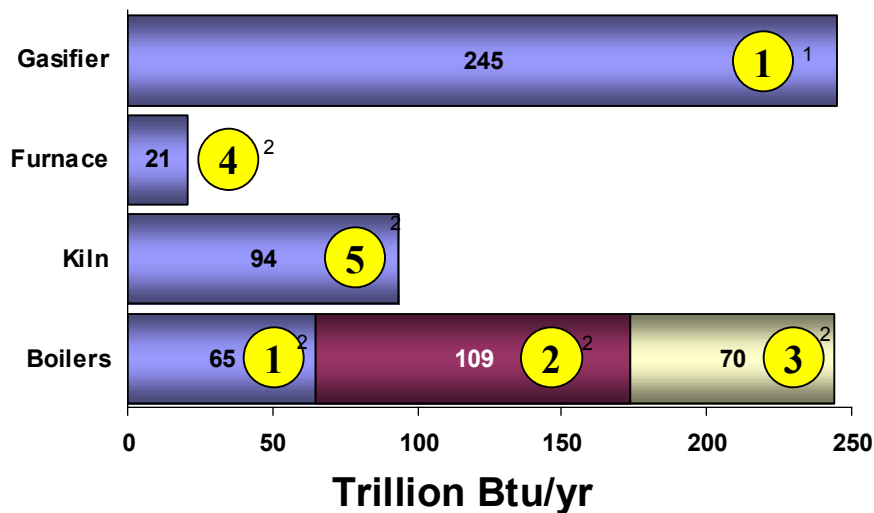
# Focus Area 1. Degradation-Resistant Materials



## Opportunity Identification: Refractory Materials

### Energy Saving Potential

(preliminary results, savings for 2020)



### IMF Refractory Focus Areas

- ① Forest Products
- ② Petrochemical
- ③ Chemical
- ④ Aluminum/Metal Casting/Glass
- ⑤ Cement/Lime

1- Princeton University, Navigant Consulting, Politecnico di Milano report on Gasification Power Generation in the Pulp & Paper Industry

2 – Crosscutting Refractory and Insulation Material R&D Needs and Opportunities for Industries of the Future, ORNL



# Analytic Basis for Materials Program Priorities

- Use roadmaps to identify the crosscutting materials priorities
- Set focus areas based on areas of greatest need among IOFs
- Quantify potential energy savings in each focus area via Opportunity Analyses
- Issue solicitations and selected projects in each focus area to realize Opportunities

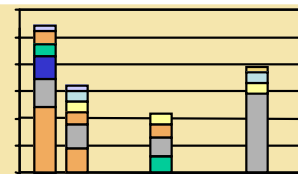
## IOF Roadmaps & Crosscutting Needs Assessment



## Focus Areas

1. Degradation-Resistant Materials
2. Thermophysical Databases and Modeling
3. Materials for Separation
4. Materials for Engineering Applications

## Barrier/Pathway Opportunities Analysis



## Projects

**SOLICITATIONS**  
**R&D PROJECTS**



# Thermoelectric Materials for Waste Heat Recovery (CPS# 16947) Barrier-Pathway Approach

## **Barriers**



- Low energy - efficiency furnaces due to heat loss
- Lack of robust, affordable, materials for TE devices

## **Pathways**



- Development of thin film thermoelectric materials
- Modeling to develop and design retrofit TE generators for implementation in waste heat stacks
- Economic analysis for implementation TE technology

## **Critical Metrics**

- TE Figure of merit  $ZT > 6$
- Production of power with an efficiency greater than 20% for a retrofit system

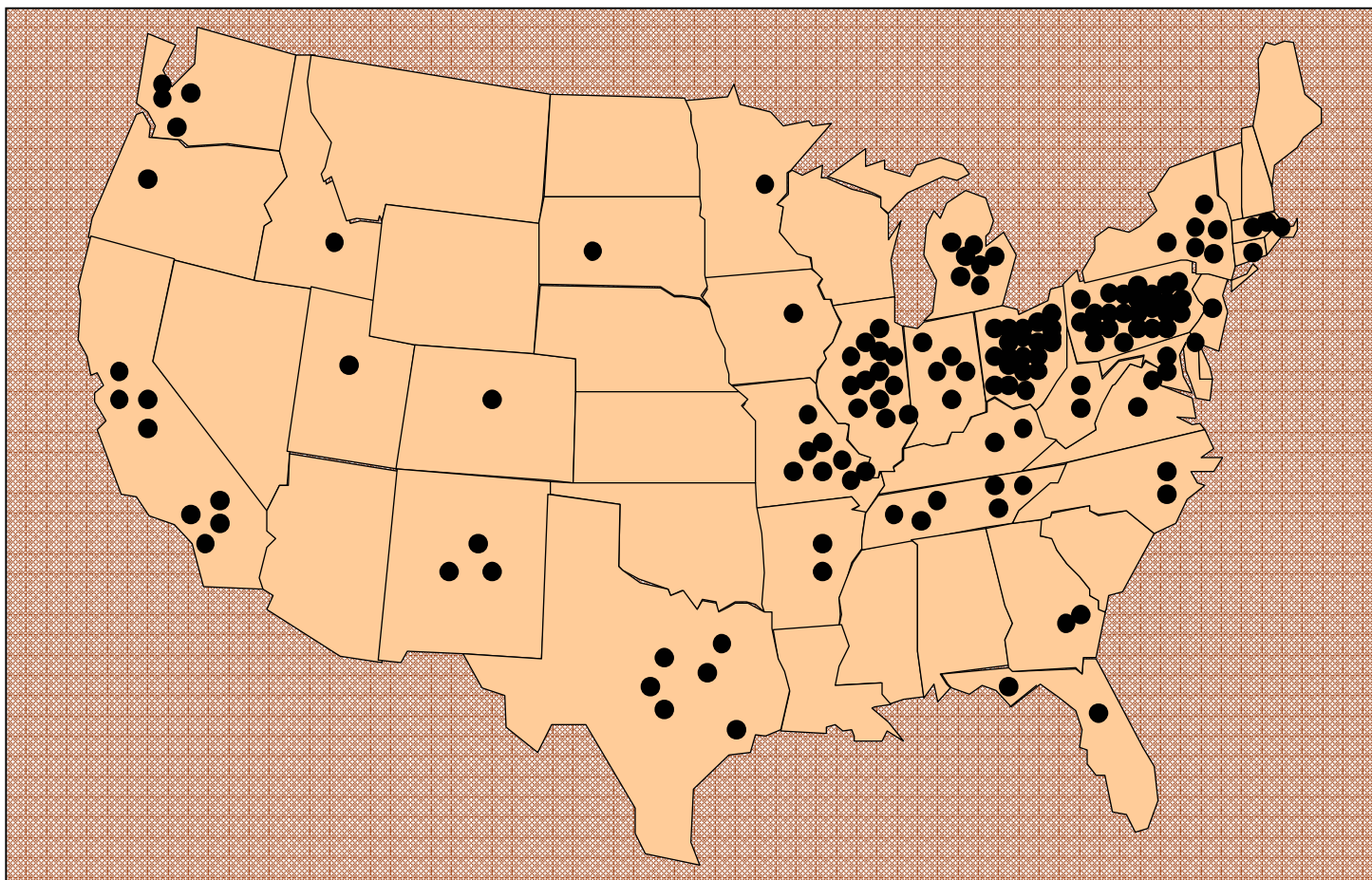
<b>Benefits (est.)</b>	<b>2020</b>
Energy Savings	135 trillion Btu
Cost Savings	\$980 million
Carbon Reduction	0.4 MMTCe



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# Broad Industry Participation

***Over 170 FY2004 Materials R&D Partner Locations***



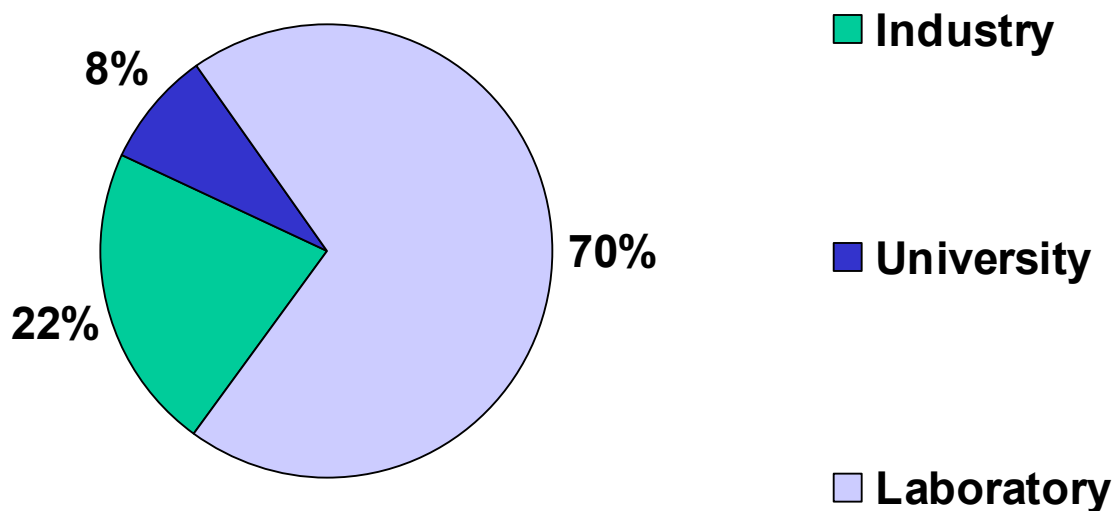
**Industry – 135**  
**Laboratories – 11**

**Universities – 25**  
**Associations - 4**



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# DOE Dollars by Partner Type FY04



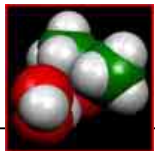


# Highlights

**Thanks for Sending in  
Weekly Highlights!!!**

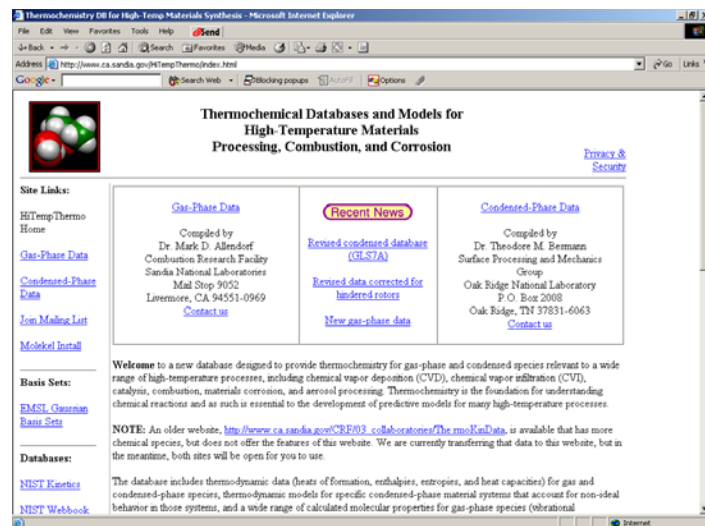


# FY03-04 Accomplishments



## Database of Thermodynamic Data for Industrial Applications Now On-Line

- Provides information for those seeking to simulate high-temperature processes for optimal material selection and failure mechanism analysis
- Contains data on over 600 gas-phase compounds and a wide range of metal oxides used in refractories
- Planned expansion will more than triple the number of compounds in the database
- Site receives more hits than any other at Sandia Combustion Research Facility



- Estimated benefits approach 12 trillion Btu/year



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## Two IMF Projects Win R&D Magazine's 2003 R&D 100 Awards

- **Novel Carbon Films for Next Generation Rotating Equipment (CPS# 1785)** provides exceptional friction and wear properties in wet, dry, and high-temperature environments. Target applications are rotating machinery applications.

**Partners:** Univ. of Illinois, Drexel Univ., Argonne National Laboratory, and industrial partners

- **Ultrananocrystalline Diamond Coatings (CPS# 1798)** improve wear resistance on mechanical pump seals. The award specifically honored the development of a large-scale, six-inch reactor used to deposit a diamond coating on materials.

**Partners:** Argonne National Lab, Advanced Diamond Technologies, John Crane, Inc.; Morgan AM&T; Coorstek Amazing Solutions; Innovative Plasma Systems GmbH (IPLAS)



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# Priorities, Plans and Activities



# Top ITP Management Priorities

- Fund excellent R&D projects
- Reduce project uncOSTed balances



# Materials Priorities

- Use Focus Area, Barrier, Pathway model to identify and fund high energy savings opportunities
- Increase effort in materials for separations, refractories, databases and modeling



# Materials Priorities

- Update IMF program plan in 2004/05
- Track implementation of results of completed projects
  - Facilitate commercialization, transfer of knowledge



# Solicitation Planning

## FY 2006 Funds

- Possibly a small solicitation in 2005 for Materials for Separations (\$1- 1.5M)

## FY 2007 Funds

- Solicitation in 2006 for Focus area priorities (depends on funds available in 07)



# Reviews and Meetings

- Corporate Peer Review, March 11-12, 2004
- NAS Corporate Peer Review, May 19-20, 2004
- ASM Symposium on *Materials for Energy Efficiency in Industrial Processes and Manufacturing* organized for ASM Materials Week, October 2004.



# Future Portfolio Reviews

- Annual Materials, Sensors and Glass Reviews
- Corporate Peer Reviews every other year



- End of Presentation



# IMF Partners FY04

